IV.—THE INVERTEBRATE FAUNA OF THE INLAND WATERS OF SCOTLAND.—PART IV. By Thomas Scott, F.L.S.

In this Report on the invertebrate fauna of the inland waters of Scotland, I propose to describe, first,—the results of a partial examination of Loch Tay in Perthshire; and second,—the results of the examination of tow-net gatherings and other material from certain Sutherlandshire lochs, collected, and forwarded to Dr Fulton, the Superintendant of Scientific Investigations, by W. S. Caine, Esq., M.P.

1.—Loch Tay, Perthshire.

Introductory.

Loch Tay belongs to the Marquis of Breadalbane and is one of the best salmon lochs in Britain.

The district about Loch Tay is known to botanists throughout the length and breadth of the land, as one of the richest in native alpine and sub-alpine plants, in the British Islands; some of the rarest of our native ferns, mosses, lichens, as well as flowering plants, have been and may still be obtained among the gullies and rocky crevices about the summits of Ben Lawers and the neighbouring mountains, and every year people interested not only in the British flora but in other departments of natural history as well are frequent visitors in the district.

Though Loch Tay and its surroundings are thus well known not only to the mere pleasure seeker but also to the naturalist, no systematic attempt has apparently been made hitherto to investigate the invertebrate fauna of the loch, and the present contribution towards that object may, therefore, be of interest.

It was during a short visit to the beautiful and picturesque village of Kenmore, in September last year, that I had the privilege of making a partial investigation of this fine Perthshire loch. Owing to the limited time at my disposal I was only able to examine that portion of the east end of the loch extending from the East Bay where the steam-boat wharf is, westward to near Fernan. There are two islands at this end of the loch—the 'Ministers Island'—which is little more than a cairn of stones; and Aidan's Isle or the Isle of Loch Tay.' King Donald IV. was drowned somewhere in the vicinity of Aidan's Isle; and here Sibylla—Alexander's Queen—died, and was buried A.D. 1122.

Depth of Loch Tay.

I was unable from want of time to take soundings of the loch, but the following notes from a paper read at a meeting of the Royal Society of Edinburgh, February 20th, 1888, by Mr James S. Grant Wilson of H.M. Geological Survey, may not be out of place. Mr Wilson's paper described the results of a recent bathymetrical survey of the chief Perthshire lochs and their relation to the glaciation of the district, and was illustrated by a carefully prepared chart of the various lochs referred to.* In this paper Mr Wilson describes Loch Tay as being $14\frac{1}{2}$ miles in length by about $\frac{3}{4}$ of a mile in average width; the surface level of the

* This paper was published in the *Scottish Geographical Magazine* for May 1888.

water, calculated from the bench mark on Kenmore Bridge, is found to be 346 feet above the sea. The general outline of the loch somewhat resembles the letter S in form but with the ends only slightly curved. The lower portion of the letter is represented by the part from Killin to Ardionaig and extends E. 25° N. about $5\frac{1}{2}$ miles, the middle portion is represented by the part from Ardionaig to Fernan and extends N. 30° E. about $5\frac{3}{4}$ miles, and the upper portion is represented by the part extending from Fernan to Kenmore, and which lies in the same direction as the west end, viz.,—E. 25° N. The length of this portio is about $3\frac{1}{2}$ miles. The deepest part of the loch is opposite Skiag, or a little over 5 miles in a 'bee line' from Kenmore; the depth here is 85 fathoms or 520 feet. From this deep part of the loch the bottom rises gradually but more or less irregularly towards each end. When the loch is standing at its summer level the western margin is often covered with thin patches of bright red sand which, on examination, is found to be composed almost entirely of minute fragments of garnets; numerous fragments of garnetiferous schist may also be obtained scattered about the shore at the east end of the loch.

Invertebrate Fauna of Loch Tay.

The Loch was examined by means of a tow-net worked from a rowing boat kindly placed at my disposal by a friend in Kenmore. No examination was made of the bottom of the Loch except where the water was shallow, that is between the steam-boat pier and the 'Minister's Island' on the south side, and from Aidan's Isle eastward on the north side. Pelagic crustacea were scarce in all the surface and under-surface gatherings, but they included one or two forms of interest, such as the curious *Bythotrephes* and the beautiful *Leptodora*. On the other hand, the material collected by dragging the tow-net through and among the bottom vegetation found growing in some of the shallower parts and especially in the vicinity of the 'Minister's Island' proved to be rich in micro-organisms; over twenty species of crustacea were obtained in this way. Several species of Mollusca, Coleoptera, Arachnida, the larvæ of dragon-flies and other insects, Rhizopoda, Rotifera, &c. were also observed in the same material. In the following lists I propose to give a record only of the species of Mollusca and Crustacea obtained.

THE MOLLUSCA.

Comparatively few species of *Mollusca* were observed in Loch Tay, and this paucity of molluscan species corresponds with what I have observed in the investigation of other deep fresh-water Lochs; the conditions physical or otherwise of such lochs do not seem to favour the development of the *Mollusca*.

1. Lamellibranchiata.

Pisidium pusillum (Gmelin).	Frequent.
,, *fontinale* (Drapɸ).	Scarce.

2. Gasteropoda.

Valvata piscinalis (Müller).	Frequent, but generally of small size.

CRUSTACEA.

The crustacea obtained were not only numerous, especially in the bottom material, but included several comparatively rare and interesting species.

1. Copepoda.

Diaptomus gracilis (G. O. Sars).	Frequent.	in tow-net gatherings.
Cyclops signatus, Koch.	Few.	in bottom material.
„ *strenuus*, Fischer.	Few.	in tow-net gatherings.
„ *viridis* (Jurine).	Few.	in bottom material.
„ *serrulatus*, Fischer.	Frequent.	
„ *magnotavus*, Cragin.	Very rare.	
„ *macrurus*, G. O. Sars.	Rare.	
„ *fimbriatus*, Fischer.	Frequent.	
Attheyella crassa (G. O. Sars).	Frequent.	
„ *pygmæa* (G. O. Sars).	Few.	

2. Ostracoda.

Cypria serena (Koch).	Few.	in bottom material.
Cyclocypris globosa (G. O. Sars).	Few.	
Candona candida. (Müller)	Few.	
„ *lactea.* Baird	Few.	

3. Cladocera.

Sida crystallina (Müller).	Scarce.	in surface and under-surface tow-net gatherings.
Daphnia jardinii, Baird.	Frequent.	
Bosmina longirostris (Müller).	Frequent.	
Ilyocryptus sordidus (Lievin).	Rare.	in bottom material.
Acroperus harpæ, Baird.	Few.	
Eurycercus lamellatus (Müller).	Frequent.	
Camptocercus macrurus Müller).	Few.	
Alonopsis elongata, G. O. Sars.	Frequent.	
Alona quadrangularis (Müller).	Frequent.	
Pleuroxus trigonellus (O. F. Müller).	Scarce.	
Graptoleberis testudinaria (Fischer).	Scarce.	in tow-net gatherings and in bottom material.
Alona guttata (G. O. Sars).	Frequent.	in bottom material.
Chydorus sphæricus (Müller).	Frequent.	
Polyphemus pediculus (Linné).	Frequent.	
Bythotrephes longimanus, Leydig.	Not common.	in surface and under-surface tow-net gatherings.
Leptodora hyalina, Lilljiborg.	Moderately frequent.	

2.—Report on Tow-net and other Material from certain Sutherlandshire Lochs, collected and forwarded by W. S. Caine, Esq., M.P.

Introductory Note.

The material so kindly forwarded by Mr W. S. Caine, and which on examination proved of considerable interest, comprised tow-net gatherings, samples of aquatic plants, and trout and trout's stomachs from Loch Mullach Corrie (Maol a Choire); samples of aquatic plants and trout and trout's stomachs from Loch Awe; and trout and trout's stomachs from Loch Assynt.

These lochs are all in the district of Assynt, Sutherlandshire.

Mr Caine when he forwarded the material, sent also at the same time a short and graphic description of Loch Mullach Corrie and of Loch Awe, as well as a sketch of each of these two lochs to illustrate some of the points referred to in his description, and as the description and sketches are of interest they are reproduced in the sequel.

In the following remarks the lochs are noticed in the order in which they are referred to above.

First.—Loch Mullach Corrie (Maol a Choire).

This is a small loch and is situated in a limestone district about $2\frac{1}{2}$ miles from Inchnadamph Inn. Loch Mullach Corrie is reported to contain what are called 'Gilleroo' or 'Gizzard' trout, though some writers are inclined to question this, but be that as it may, the beauty of the coloration and of the form of the Loch Mullach Corrie trout are undoubted and their edible qualities are also reported to be excellent.

Description of the Loch.

Mr Caine's description of loch Mullach Corrie is as follows:—'The 'loch is commonly known as the "Gilleroo" Loch because it contains '"Gilleroo"trout. No one is able to explain how they came there; they 'are said to be the only trout of their kind found in Scotland, though 'very abundant in Irish lakes, especially in West Meath. The loch is 'about 5 furlongs in length by $2\frac{1}{2}$ furlongs in width. I have sounded 'its depth in 35 places; in a direct line through its length, in the 'middle; and in two direct lines across, at equal distances apart (as 'shown in the sketch—fig. 1). Along the length the soundings are 3 'feet, $4\frac{1}{2}$, $4\frac{1}{2}$, $4\frac{1}{2}$, 5, $5\frac{3}{4}$, $5\frac{1}{2}$, 6, 6, 6, $5\frac{1}{4}$, 5, $4\frac{3}{4}$, $4\frac{1}{2}$, and $4\frac{3}{4}$ feet. Across 'the first line (a) the soundings are $6\frac{1}{2}$ feet, 9, 8, 6, 6, $5\frac{1}{4}$, $5\frac{1}{2}$, 5, and $4\frac{3}{4}$ 'feet. And across the second line (b) 4 feet, 6, $5\frac{3}{4}$, $5\frac{3}{4}$, $5\frac{1}{2}$, $5\frac{1}{2}$, $5\frac{1}{2}$, 6, '$6\frac{1}{4}$, 6, and $3\frac{1}{2}$ feet; so that the average depth of the loch is about '$5\frac{1}{2}$ feet. The bottom, round the edges, is gravel and stones; along one 'side the stones and gravel are clean and bright, along the other side 'they are covered with a slimy vegetable deposit. The bottom of the

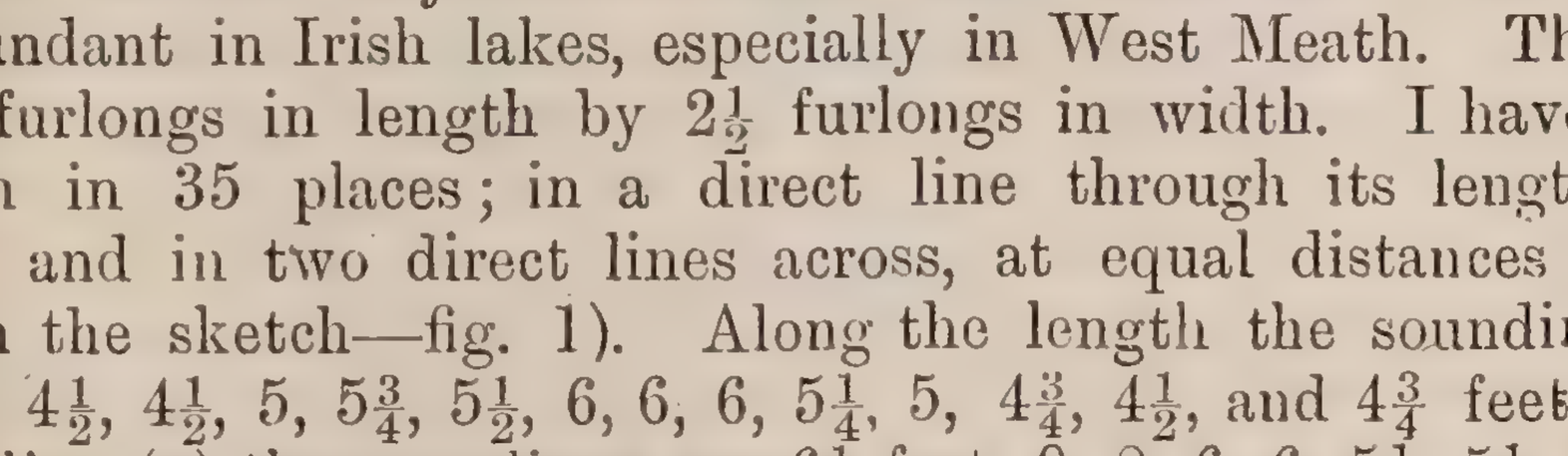

Fig. 1.

'basin of the lake is soft black mud . . . from this mud spring dense 'masses of weed of three varieties. The loch is fed with spring water,

'and is very pure and transparent. There are large quantities of fresh-'water shrimps (*Gammarus pulex*) all over the loch,—among the gravel, 'under stones, and sticking to the weeds. Leeches are also very 'abundant, but I do not find fly-life very plentiful. There are a great 'quantity of curious gelatinous substances adhering to stones and lying 'about in the gravel shoals which I never noticed before in any lake."

The crustacean fauna of the little loch, to judge from the tow-net gatherings sent to me, is evidently very abundant and very interesting. One of the Copepods from this loch—*Diaptomus serricornis*—is new to the British Islands. Since the discovery of *Diaptomus serricornis*, Lilljeborg, in Loch Mullach Corrie it has been ascertained that the same species was found by Mr David Robertson of Millport many years ago (1867) in a pond near Lerwick, Shetland, but had remained unnoticed in print till the discovery of the species in the Sutherlandshire loch. A variety of *Daphnia pulex* (Linné), having the distal half of the hairs on the antennules and also the posterior spine of a black colour, was frequent in the tow-net gatherings from Loch Mullach Corrie; I propose to call this variety *nigrispinosa*. The 'shrimp' (*Gammarus pulex*, Linné) which Mr Caine describes as abundant in the loch is an evidence of the purity of the water. This is a species that can only thrive in water that is more or less pure; if transferred to impure water it very soon sickens and dies. The leeches, referred to in the description of the loch, belong to the genus *Hæmopsis* (the horse-leech) which is found in ponds and ditches all over the country. Seven stomachs of trout from this loch were sent by Mr Caine and they all contained *Gammarus* in greater or fewer numbers, in one or two of the stomachs there were along with the *Gammarus* a few insects, or portions of insects, chiefly of the *Phryganeidæ*. The plants that were forwarded comprised specimens of a species of *Chara*; of *Fontinalis antipyretica*, —a moss common in some fresh-water streams and shallow lakes; of *Littorella lacustris*; of *Menyanthes trifoliata* (the Bogbean); of *Millifolium spicatum* (water-milfoil); and a species of *Potamogeton*, or pond-weed. Among the animal organisms specimens of the curious little so-called 'water-bears' (*Tardigrada*) were observed specimens of insects chiefly of the *Phryganeidæ* and *Coleoptera*, specimens of the *Hæmopsis*, already referred to, and the following crustacea were also obtained.

AMPHIPODA.

Gammarus pulex (Linné).	Abundant.

COPEPODA.

Diaptomus serricornis, Lilljeborg.	Frequent.
Cyclops signatus, Koch.	Few.
,, *thomasi*, Forbes.	Few.
,, *virides* (Jurine).	Few.
,, *serrulatus*, Fischer.	Few.
,, *affinis*, G. O. Sars.	Few.
Attheyella crassa (G. O. Sars).	Few.

CLADOCERA.

Daphnia pulex (Linné).	Frequent
,, ,, var. nigrispinosa.	Frequent.
Bosmina longirostris (Müller).	Frequent.
Alonopsis elongata, G. O. Sars.	Few.
Alona quadrangularis (Müller).	Few.
Graptoleberis testudinaria (Fischer).	Few.
Chydorus sphæricus (Müller).	Frequent.

Second.—Loch Awe.

This is a small loch about four miles from Inchnadamph and nearly equidistant from Inchnadamph and Altnacealgach. The River Loanan flows out of this loch into Loch Assynt. The trout in Loch Awe are usually not very large—their average weight being about the one-third of a pound, their flesh is red coloured, and they are said to be of good quality. There are a number of small islands in the loch, most of them are situated near the middle, and so arranged as to divide the loch into two nearly equal portions. The loch is shallow and in some places is much overgrown with aquatic vegetation. Samples of the more common plants growing in Loch Awe were sent along with the material from Loch Mullach Corrie, they comprised specimens of *Littorella lacustris*, *Millefolium spicatum*, *Juncus bulbosus*, and of two species of *Potamogeton*. No tow-net gatherings were sent from this loch, but the following three species of crustacea were obtained by an examination of the plants mentioned above, viz.,—*Sida crystallina*, *Daphnia*, sp. (?*pulex*), and *Attheyella crassa*. A specimen of *Lernentoma* was obtained attached to the gills of one of the trout from this loch.

Twelve stomachs of trout from Loch Awe were examined, three of them were found to be empty; six contained the remains of insects only; two, the remains of insects and *Gammarus*; and one, the remains of the larvæ and larvæ-cases of 'Caddis-flies' (Phryganeidæ.)

Description of Loch Awe.

Mr Caine describes Loch Awe as follows:—'This is a small loch about 'three quarters of a mile long by a quarter of a mile wide, it is divided 'into two parts by a chain of wooded islands with stoney and gravelly 'beaches. The depth of the loch over all is from 5 to 7 feet at 'the distance of about 20 feet from the shelving margin. The two 'ends have stoney bottoms, quite clear of weeds for about one-third to 'one half of their area, and the shore round the islands is also free of 'weeds. There are practically two great beds of weeds—one across the 'middle of each of the two portions of the loch—which I have shaded 'on the rough sketch (from memory) given below; these weeds are the 'same growth—three varieties—as those I have sent from the "Gilleroo" 'loch, which is two and a half miles distant from Loch Awe.' Fig. 2 'is the sketch of the loch referred, showing the beds of weeds at W.W.

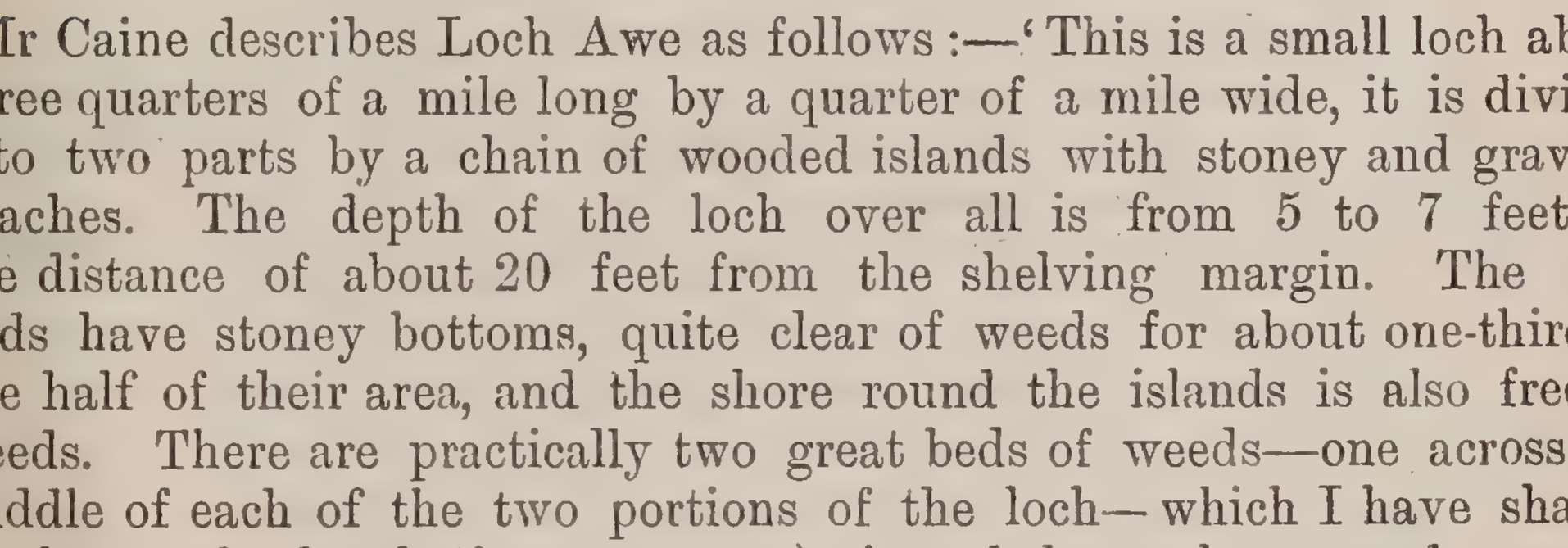

Fig. 2.

Third.—Loch Assynt.

This loch, well known to the angler for the excellent sport it furnishes, is of considerable area, being about eight miles in length by one mile in

breadth. Several streams, including the Loanan from Loch Awe, flow into it, and the River Inver, which, after a run of about 6 miles, falls into the sea at Loch Inver, flows out of it. Loch Assynt contains salmon, sea trout, common trout, and *Salmo ferox*—a variety of *Salmo fario*. No tow-net gatherings nor samples of acquatic plants were sent from this loch, but judging from the number and excellence of the fish contained in the loch its invertebrate fauna must be abundant, an investigation of which might be expected to yield interesting results. Twelve stomachs of trout from this loch were examined and were found to contain numerous insect and crustacean remains as shown by the following tabulated statement of the results of the examination.

Table showing the results of the examination of twelve stomachs of trout from Loch Assynt :—

No. of stomach.	Contents of stomach.
1	Remains of larvæ and larvæ-cases of 'Caddis-flies.'
2	Several specimens of *Valvata piscinalis* (a fresh-water mollusc).
3	Remains of *Limnæa peregra*, *Gammarus*, and larvæ-cases of Caddis-flies.
4	Remains of insects—species doubtful.
5	*Limnæa peregra*, *Gammarus*, remains of insects.
6	The same as 5.
7	*Valvata piscinalis*, elytra and other parts of beetles (*Coleoptera*).
8	*Valvata piscinalis*, and remains of insects.
9	Several *Limnæa peregra*, and larvæ-cases of 'Caddis-flies.'
10	One *Limnæa peregra*, remains of *Gammarus*, and 'Caddis-flies.'
11	Two *Limnæa peregra*.
12	Remains of *Gammarus*, and larvæ and larvæ-cases of 'Caddis-flies.'